Rockery at the University of Pennsylvania, built in 1881. By Eli K. Price.

(*Read before the American Philosophical Society, Dec. 16, 1881.*)

The form of the White Oak leaf is used and the rocks so placed, that every one may be seen. They are arranged according to the places where they were found, to show how nature has disposed of them.

SECTION I.—The large upright black stones at the three corners (*a*) came from the tunnel on Thirtieth Street, near Master, 40 feet below the curb, 50 to 60 below the gravel hill.

The quarried stones (*b*) are from the quarry of Price & Moore, next westward of the Woodlands Cemetery; those next east (*c*) from the quarry of Samuel C. Bunting, Junior, south of Walnut, west of Forty-fourth Street; those farther east (*d*) from William P. Supplee's quarry east of Fifty-third Street, southward of Girard Avenue; those marked (*f*) from McKinley's quarry on Rittenhouse Street, near the Wissahickon; and all the other quarried stones in this section (*e* and *g*) are from grounds of Eli K. Price, on both sides of Twenty-ninth and Thirtieth Streets and of Master and Jefferson Streets; and the residue of this section is covered by transported rubbed rocks from the gravel hills of the same and adjoining grounds, at an elevation of about 100 feet.

SECTION II is wholly covered by white and light-colored rocks, transported and polished, from grounds of George S. Harris, J. Clothier, L. Dolby and others, on south side of Market Street, from Forty-eighth to Forty-ninth Streets, a space of 480 feet by 246 feet, from a sand and gravel hill of a height of about 100 feet above tide. The large white rocks at the ends of this section lay near together, and show that when transported they came as one rock.

SECTION III.—Letter *i* are stones from the south side of Chestnut Street, extending from Forty-seventh to Forty-eighth Streets, from a gravel and sandy elevation of about 70 feet above tide, from the grounds of the Byvam heirs and others.

SECTION III.—Letter *k* are stones from both sides of Forty-fifth Street and of Spruce Street, from grounds of Albert S. Letchworth and others. The elevations were about 90 feet above tide.

SECTION IV is wholly covered by stones from the City Almshouse grounds, westward of Thirty-seventh Street, and both sides of Spruce and Thirty-eighth Streets, from gravel about 85 feet above tide.*

* These elevations are based upon the following *curb heights*, which are about ten feet lower than the gravel banks had been:

PHILADELPHIA, December 8th, 1881.

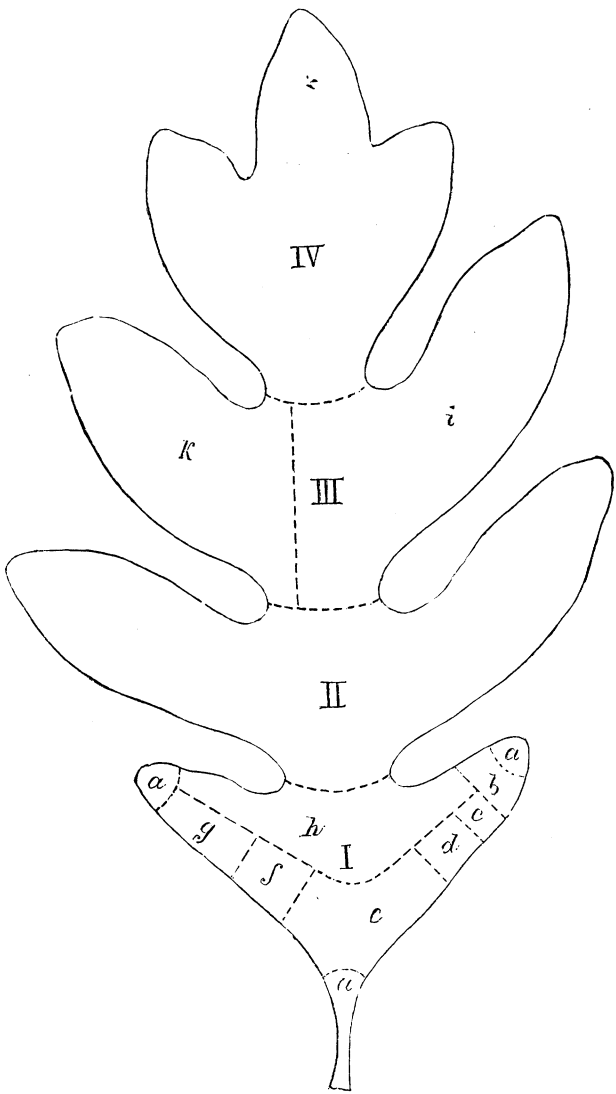
Dear Sir:—The following are the elevations of the *curb* corners above tide, asked for in your note of 7th inst.:—Jefferson and Twenty-eighth, 96.57 feet; south side of Market and Forty-ninth, 88 feet; south side of Chestnut and Forty-seventh, 64.74 feet; north side of Spruce and Thirty-eighth, 76 feet, and south side ditto, 75.50 feet; Spruce and Forty-fifth streets, 83.50; Tunnel, Thirtieth and Master streets, 40.70 to bottom.

Yours, &c.,

SAMUEL L. SMEDLEY, Chief Engineer and Surveyor.

TO ELI K. PRICE.

PLAN OF ROCKERY



ON THE CAMPUS OF THE UNIVERSITY OF PENNSYLVANIA.

For the taking of the above stones I had, as far as known, the permission of the owners or their representatives, and for them the University of Pennsylvania and citizens owe thanks to the City of Philadelphia, to William Baldwin, Chief Commissioner of Highways, George S. Harris, Dr. Twaddell, J. Clothier, L. Dolby, Samuel C. Bunting, Jr., Albert S. Letchworth and others, who gave them these valuable objects of curiosity and science without charge. The hunting, hauling and building them into a Rockery has been my occupation, with men and carts taken from my quarry for one day or more of the week, from the beginning of June to the end of December, 1881. The purpose of gathering these rocks has been for their preservation, and convenience of study by professors and students, and all interested in the important questions to which they give rise.

What do these rocks say to us here to-day? Plainly they show the minerals they contain. But we go back from these to the period of primary rocks, to the granites and other igneous rocks, whose melting and moving power was fire, and whose disintegrations furnished the material for the stratified rocks deposited by later pervading waters; and these also again, becoming disintegrated by frost, heat and water, also became modifying and different sources for their last granular depositions in strata. We have here from the quarries gneissic rocks, the first strata of the secondary formation; and we have the transported rocks, also deposited by water, consisting of materials that have undergone many changes of stratification and re-stratification as well as of attrition.

In the study of these rocks we pass from a time when no life was on this globe into periods since the beginning, spoken of in the first verse of Genesis, wherein all life has been created; and therein perceive the methods of the Creator in the structure of this globe.

The transported rocks demand special explanation. We ask to know what are their compositions? What their names? Where were they in the regular order of the geological stratification? Where geographically? How were they torn from their places? How transported to where found round our University? How polished? How lifted upon the hills? Had we really a great "continental glacier" to bring them here? Was the world made, peopled, civilized for the repetition of the disaster of the "Great Glacier"?

These are some of the questions for the mineralogists and geologists, in and out of the University, to answer: it is hoped that they may long incite to interesting and useful study. The objects are the oldest, but the questions are of new presentation.

Charles E. Hall, of our State Geological Survey, began to observe some of these rocks in 1875, and has partially answered the above questions, according to his observations and convictions at that time. (See Proceedings Amer. Philos. Soc., No. 95, Nov. 1875, p. 633.) He followed Agassiz, Lyell, Geikie, Croll, Dana and Newcomb in placing the south line of the great continental glacier at and below the 40th degree of north latitude,

and naturally inferred that it was the cause of the deposit here of these transported rocks.

In 1878 Professor Cook published his "Report on the Geology of the State of New Jersey," and placed the glacial drift northward, on a line from a point of the Raritan river (lat. 40° 30′), thence N. W. to Denville (near the 41°), thence westward and south-westward to Belvidere on the Delaware (lat. 40° 50′).

In 1881 Professor Henry Carvill Lewis, also of the Second Geological Survey of Pennsylvania, has traced the southern line of the glacial drift through this State for a distance of about 400 miles. He informs me, in advance of publication, that this line, which is marked by a terminal moraine, starts at a point opposite Belvidere, and passes in a north-west direction over the Kittatinny and Pocono mountains, and across the Lehigh and Susquehanna rivers into Lycoming county, where it ascends the Alleghany Mountains, and continues thence in a nearly straight line into Cattaraugus County, N. Y. (lat. 42° 15′). It there curves south-westward and, re-entering Pennsylvania in Warren County, passes south-west through Venango, Butler and Lawrence Counties, until in Beaver County (lat. 40° 50′) it crosses the Ohio State Line.

In his "Essay on the Antiquity and Origin of the Trenton Gravels," Mr. Lewis states his belief as to "the Terminal Moraine" which he had explored, which "winds over hills and across valleys in such a manner that by no other known agency than a great glacier could it have been produced," p. 17. This is the product, he says, of the last glacial epoch. There is some evidence that in an earlier period a glacier advanced south of that limit. To the north "the great glacier has left undoubted traces, in the universal covering of unstratified boulder clay or *till*, in the smoothed and grooved rocks, the transported boulders, &c." "There are many facts which indicate that the ice, even close to its lower terminus, had a thickness of over 1000 feet, which increased northward," pp. 18, 19.

Mr. Lewis also speaks of a post-glacial flood, "at a time when the river [Delaware] was larger than at present," as a "conclusion warranted by many facts, and as a cause of the deposit of the Trenton gravels," p. 19, &c.; and "that the boulders upon its surface were dropped from ice-cakes is, however, probable," p. 23.

Did, then, these transported rocks come here by glacial action? If so, at a first or second glacial epoch? By a great glacier or by floated ice? Were they *lifted* upon the hills by ice or water? Or was the earth sunk when they were brought, and the rocks afterwards lifted by the rising of the earth's surface? Professor Lewis gives to these transported rocks a transporting cause common to the Philadelphia red gravel and our brick clay, at "an epoch of submergence as indicated by the elevation of their deposit;" and that "it is probable that this clay may be assigned to a period when the land stood 150 feet or more below its present level, and

when the cold waters from the melting glacier bore ice-rafts which dropped their boulders," pp. 4, 5, 6, 7.

It seems apparent that the supposed ice-sheets or glaciers have been greatly magnified by the first-named glacialists, both in their thickness and extent, by reason of their taking the earth as a stable land-mark, whereas it is less stable than the ocean. Great rocks have been taken for boulders, though in *situ*, because they have been abraided by floating ice-sheets and the rocks they have borne; rocks supposed to have been transported and *upheaved* by glaciers, have been floated *downwards* by ice rafts or icebergs, and afterwards have been lifted by the rising oscillation of the earth; and mountain sides are supposed to have been scored by great glaciers 6000 or more feet thick, yet the scorings may have been made much lower, and afterwards have been carried upwards to such height by the rising mountains. It seems not to be sober philosophy to seek abnormal causes when the ordinary laws of nature may afford the sufficing explanation. A sufficient cause is enough. The mountain tops have been higher and colder, and been since lowered by erosions; their oscillations have been upwards and downwards; the valleys have been raised by the *debris* of the mountains, and have risen and fallen with the roeks beneath them; and how frequent are these alternations, and for what beneficent purpose, may be seen in every seam of coal in the carboniferous regions; for each was grown on a plain in the open air, and had the light and heat of the sun, and then sank below the waters, that these might deposit the particles to make the protecting covering rocks for the unknown centuries that followed, when again all were corrugated and lifted to bring them into human reach for man's uses, in ages when skillful enough to win and apply the coals, the products of the soil, water, air and sun, and the life that God gave to the plants at a remote and momentous era of creation.

It becomes us not to unreasonably impeach the goodness of the Creator. It seems, from all we know, not likely that He would destine the fairest portion of this earth, where man has best developed his civilization, to destruction by ice. The physical sciences, as well as those of morality and religion, furnish the proof that there is a limitation of forces that conserve nature, and afford us the foundation of a scientific faith that man's best home on earth is an abiding one for the race. Yet must science observe all facts and heed all reasonable reasons; and doing so mankind, it is believed, will gain reassurance that they are held in safety by a Creator who forever conserves His works.